

Relation between aquaculture with fish disease & health management: A review note

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Abstract. In Aquaculture production, one of the major headaches of the farmer is disease. Production cost of farmer increases due to reduction of the quality and quantity of yields for disease. Due to intensification of culture system, disease is now becoming a major threat which ultimately reduces the production. Currently, the aquaculture industry facing it more difficult to assure its sustainable development. Bangladesh already achieved self-sufficiency in fish production and now it is time to achieve safety in this sector for both in production and quality. Present study reveals the causes, significance, and control and mitigation of fish diseases in aquaculture production to provide better information on diseases and health management.

Keywords: Disease, Health management, Aquaculture

Introduction

Global fish production peaked at about 171 million tons in 2016, with aquaculture representing 47 percent of the total and 53 percent if non-food uses (including reduction to fishmeal and fish oil) are excluded. Aquaculture continues to grow faster than other major food production sectors although it no longer enjoys the high annual growth rates of the 1980s and 1990s (11.3 and 10.0 percent, excluding aquatic plants). Average annual growth declined to 5.8 percent during the period 2000–2016, although double-digit growth still occurred in a small number of individual countries, particularly in Africa from 2006 to 2010 (FAO 2018). Disease is a condition in living organisms in which normal physiological functions are being impaired due to alteration in the body systems and typically manifested by distinguishing signs and symptoms (pathological symptoms) (Idowu *et al.* 2016). However, healthy fish have adequate resistance against diseases; they can adapt to reasonable environmental changes and in turn resist diseases (AFCD Hong Kong 2009, Govind *et al.* 2009). Nonetheless, diseases occur in fish (Francis-Floyd 2015) but before an active fish disease is developed in a culture system pathologically linked factors are involved.

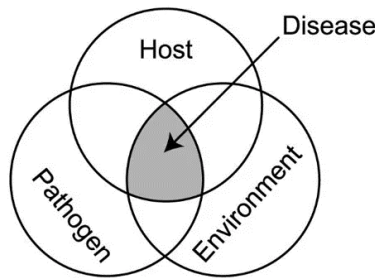


Fig. 1. Association of disease by Snieszko's (1974).

Disease in fish results from the association among several factors (Fig. 1). In a culture system, when the pathogen load increases due to unfavorable external factors (poor water quality parameter, or other stressors), above what the natural resistance of the fish cannot tolerate, fish become vulnerable to pathogenic infections and it results stress and finally to diseases. Also, external factors of water may cause drastic changes in water quality and lower fish resistance. When these happen, fish become susceptible to diseases, even the risks of fish kill is heightened.

Types of fish disease: Different types of fish disease are illustrated by the following figure.

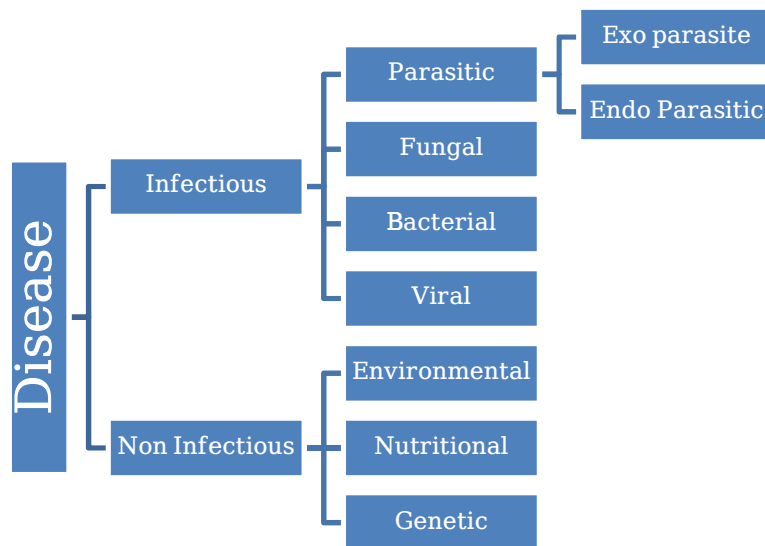


Fig. 2. Types of diseases.

Infectious disease: The diseases which are caused by pathogenic organism like viruses, bacteria, fungi or parasites are known as infectious disease. Fish become vulnerable to pathogenic infections when there are stressors (environmental abnormalities, water quality deterioration, unbalanced nutrition, or bodily injuries) which weaken fish natural resistance

(immune system). Infectious diseases pose a unique problem of diagnosis (Govind *et al.* 2009). It can be occurred both externally and internally. In Bangladesh these are the most prominent diseases and need to control the outbreak. The different types of infectious disease are given below.

Parasitic disease: Parasites of fish are not strictly pathogens, but they make a convenient classification as infectious disease of fish (Paperna 1996), as they are often responsible or followed by secondary bacterial or fungal infections. It may be external or internal. Fish parasites attack the gills, skin, gut, or as a grub-like worms in fish muscle tissue causing irritation, impaired function, weight loss, and eventually fish kill (Francis-Floyd 2005). Most protozoan infections are relatively easy to control using standard fishery chemicals such as formalin, or potassium permanganate (Francis-Floyd 2005). Examples of parasitic infections include Ichthyophthiriasis (White Spot Disease), Chilodonelliasis, Whirling Disease, Lernaeosis, Dactyrogryosis, Gyrodactylosis, Trichodiniasis, Anchor worm infestation and Copepods (commonly known as fish lice or *Argulus*) (Table I).

Table I. Common fish disease with causative agents, sign and symptoms, and treatment

Types	Name of Disease	Causes	Host	Sign and Symptoms	Treatments
Non Infectious Disease					
Parasitic	Ichthyophthiriasis (White Spot Disease)	<i>Ichthyophthirius multi fliis</i>	Carps, barbs, catfish	Whitish spot on body surface, fin and gill	Formaldehyde
	Whirling disease	<i>Myxosoma cerebralis</i>	Carps, barbs, catfish	Abnormal movement	Maintain good water quality parameters
	Lernaeosis	Anchor worm (<i>Lernaesp.</i>)	Carps, barbs, catfish, snakehead	Small thread like worm attach to body surface, irritation, slow growth	Formalin, Salt, KMnO ₄
	Argulosis	<i>Argulus</i> sp.	Carps, barbs	Abnormal movement Irritation	Diptrex
Fungal	Saprolegniasis	<i>Saprolegnia</i> sp.	Carps, barbs	Skin damage and fail to osmoregulation	Reduce organic load, External disinfectant treatments– Salt formalin,
Bacterial	General Septicemia	<i>Aeromonas hydrophila</i>	Carps, barbs, catfish, snakehead perch	Skin ulceration Distended abdomen Lesion at the base of fin	Use of antibiotic, Proper stocking density
	Columnaris	<i>Flexibacter columnaris</i>	Carps, barbs, catfish, snakehead perch	Anorexia, whitish plaques eroding affected area (mouth, body surface, fin, gills), orange lesions.	
	Furunculosis (Fin Rot)	<i>Aeromonas salmonicida</i>	Carps, barbs, catfish, snakehead perch	Inflammation (intestine and anus), lesions and bloody colored fluid in muscle and skin, fin rot	
	Streptococcis	<i>Streptococcus</i> sp.	Perch, catfish	Irregular movement, Eye protrusion Opaqueness of eye Enlargement of internal	

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				organ	
	Vibriosis	<i>Vibrio parahaemolyticus</i>	Shrimp	Erratic swimming or swimming near the bottom of the pond; Change in color; Reduced growth; Whitening of the hepatopancreas; Reduction in size of hepatopancreas; Soft texture of the exoskeleton; spots or streaks on the hepatopancreas	
Viral	Lymphocystis	Lymphocystis virus (<i>Iridovirus</i>)	Salmons, trout, carps	Small, pearl-like tumefactions on skin, fins and tail, abnormal swimming or anorexia	No specific treatment
	Viral Nervous Necrosis (VNN)	Betnodavirus (<i>Nodaviridae</i>)	Salmons, trout, carps	Accumulating necrosis of neural cells of the brain, retina and spinal cord (up to 100% mortality in young fish)	No specific treatment
	TiLV	Tilapia Lake Virus	Tilapia	Enlargement of internal organs	No specific treatment
Non-Infectious					
	Broken back	Vitamin C deficiency	Cat fishes	Skeletal deformation	Preventive measures – Vitamin C added to feed
	Fatty liver	High fat feed	-	Anorexia, bone defect or anaemia may occur	Improve feed quality and use suitable additive
	Asphyxia	Low DO	All fish species	Fish gasping for air	Aeration

(Source: Bowser and Buttner 1993, Francis-Floyd 2005, Ogunnoiki 2009, AFCD 2009, Crane and Hyatt 2011, Pridgeon and Klesius 2012, BFRI Final Report 2018)

Fungal disease: Fungi are unavoidable and always present in pond but do not usually cause disease in healthy fish (Francis-Floyd 2005, Govind *et al.* 2009). It may be responsible for secondary infection. They colonize damaged (or dead) tissues, on the external parts of fish which arise as a result of external parasite, bacterial infection, or injury by handling. The most significant fungal infection of fish is Saprolegniasis (Table I). Formalin (concentrations range) is effective against most fungal infections. It is also of importance to address the original problem of fungal infections since fungi are usually secondary problem (Francis-Floyd 2005).

Bacterial disease: Bacteria are mostly common causative agent for fish diseases. They become a problem when fish are exposed to stressors (Omojowo and Sogbesan 2003). The actual role of bacteria in pond may vary from that of a primary pathogen to that of opportunist invader of a host rendered moribund by some other disease processes (Paperna 1996). Bacterial infections are considered the major cause of mortality in aquaculture (Govind *et al.* 2009). That means bacteria may be opportunistic besides the main causative agent. Among the common bacterial infections of fish are: Streptococcosis (*Streptococcus* sp.), Columnaris (*Flexibacter*

columnaris), Furunculosis (*Aeromonas salmonicida*), Piscine tuberculosis (*Mycobacterium marinum*) and Vibriosis (*Vibrio* sp) (Table I). Antibiotics are commonly used in the treatment of bacterial infection of fish. Various vaccines including bacterin and subunit vaccine have also been developed (Pridgeon and Klesius 2012).

Viral disease: Viruses occur in particles and they are obligate pathogens. They depend on the synthesizing structure of the host cells for replication. Viral diseases of fish are difficult to diagnose and control with medications (Francis-Floyd 2005). Lymphocystis has been reported in Africa Cichlids, including species of *Tilapia*, *Oreochromis* and *Haplochromis* (Paperna 1996, Omojowo and Sogbesan 2003). TiLV is most common viral disease for Tilapia Fish (OIE 2017). Other fish diseases of viral origin include Infectious Pancreatic Necrosis (IPN), Infectious Haematopoietic Necrosis (IHN), Channel Catfish Virus Disease (CCVD) and Viral Haemorrhagic Septicaemia (VHS). The best control measure to viral infections is prevention. Vaccines seldom control viral disease of fish (Bassey 2011).

Non-infectious diseases: Non-infectious diseases (systemic diseases) are caused by non-living factors rather than living agents. The diseases are either congenital (such as genetic anomalies or neo plastic conditions) or iatrogenic (induced by external conditions such as environmental or nutritional problems). Non-infectious diseases are not contagious and medications are generally not indicated for them (Francis-Floyd 2005). However, iatrogenic condition can usually be reversed by removing (or adjusting) the. Non-infectious diseases of fish include.

Environmental diseases: Environmental diseases result from inadequacies in the physical and chemical characteristics of the pond water. They are the most important among the non-infectious diseases in commercial aquaculture (Francis 2005). Environmental problems (Table I) include depletion of dissolved oxygen, extremes in pH, high ammonia, high nitrite, natural or man-made toxins, or mechanical trauma (caused by rough handling, overcrowding, low water levels, or predation). Proper water quality management and handling are necessary in preventing most environmental problems. Prompt disinfection of fish injuries with suitable disinfectants at recommended dosage is encouraged to prevent pathogen infestation.

Nutritional diseases: Nutritional diseases are due to excess or deficiency in fish nutritional requirements (carbohydrate, proteins, lipids, mineral salts and vitamins). Most nutritional diseases are difficult to diagnose because of their chronic nature, with the condition only manifesting over a long period of time (Abowei *et al.* 2011). Signs of nutritional disease can also be marked by secondary disease condition due to pathogens (Abowei *et al.* 2011). Examples of nutritional diseases in catfish include “broken back disease” caused by vitamin C deficiency (Table I), and “no blood disease” related to folic acid deficiency (Francis-Floyd 2005). Nutritional diseases can be avoided through proper feeding practices.

Economic significance of disease and aquaculture: Aquaculture industry plays a vital role in many countries in the world especially developing countries in south-east Asia. In Scandinavian Countries, the fisheries sector has an impact on their economy. Disease is one of the major problems in aquaculture sector and it was documented by several authors including (Francis-Floyd 2005, Bondad *et al.* 2005, Brun *et al.* 2009, Idowu *et al.* 2016, Ali *et al.* 2014). Most of the authors mentioned that, fish disease slow the development in various ways such as directly

like loss of production, increase inputs cost and indirectly, through cost to society (social, welfare and environmental), adjustment in market share.

World Bank in 2006 reported global loss of about US \$3billion per year to aquaculture production and trade due to disease (Subasinghe *et al.* 2001, Brunet *et al.* 2009). Significance of fish diseases can also be in form of investment in disease research and control, along with health management programmes. However, in the foreseeable future, there will be increasing demand for such assessments in order to gain attention and continuous support from both the public and private sectors (Bondad *et al.* 2005). Moreover, discovery of pathogens and unapproved drugs in aquaculture products has also continued to generate issues including rejection of products, enforcement actions against involved trade parties (country, industry, importer, etc.), serious trade disruption and heavy financial losses (Karunasagar 2012).

Diagnosis and treatment: Healthy fish easily withstand with environmental changes and with disease but when it is in stress condition the healthy turns into Weak and ultimately affected by disease. However, since most disease causing agents are usual component of pond water environment, disease problem is inevitable in aquaculture production (Govind *et al.* 2012). The following processes are used in fish diagnosis (Fig. 3).

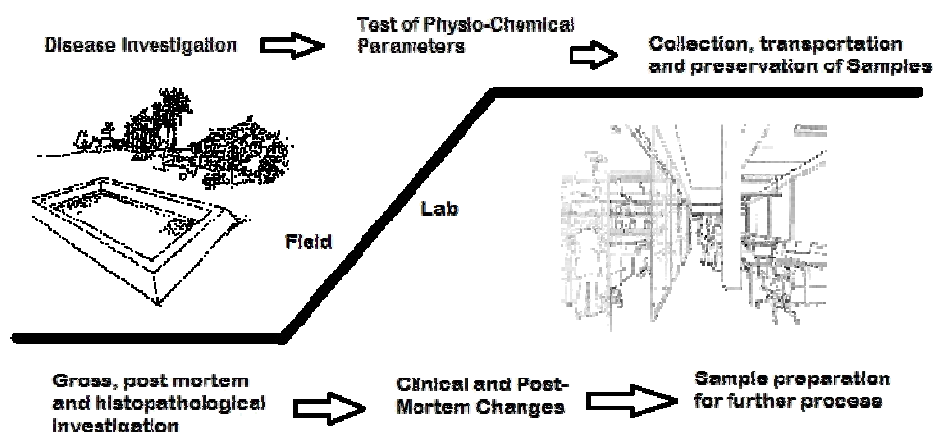


Fig. 3. Diagnosis process of Fish Disease.

Of the appropriate (approved) remedial actions/treatments for fish diseases; a change in management is necessary in most cases, while in some other situations it is necessary to add antibiotics to the feed (for internal bacterial infections) or chemical to the water (usually for external parasite infestations) (Idowu *et al.* 2016, Ogunnoik 2009). Table I indicated some remedial actions/treatments to some commonly encountered fish diseases in commercial aquaculture. In case of sudden disaster, Rahman *et al.* 2018 measured on spot analysis of water quality indicated that the low level of DO was the primary cause for the mass mortality of the fishes in *haor* region in Bangladesh.

Prevention and control: Prevention is better than treatment, this word is appropriate for fish disease. Most of the diseases are stress related and effective control depends on good management practice. The aim of fish health management should be-

- Reduce the number the disease fish
- Enhance natural immunity of fish
- Provide favorable condition for fish
- Produce healthy and fish

At regional (national) level the following highlighted strategies are applicable for proper and effective implementation of health management (disease prevention and control) practices in aquaculture production. As noted by (Bondad *et al.* 2005), these are general strategies currently being implemented in the Asia Pacific region (but having applicability to other regions of the world), and apply to all infectious diseases:

- OIE's Aquatic Animal Health Code (OIE 2003)
- National strategies on aquatic animal health management
- Research
- Manpower development
- Infrastructure
- Quick response to Sudden Disease

Conclusions

Most of farmers are with little or no knowledge of aquaculture health management and with inadequate opportunities to improve management skills and respond effectively to disease problems. Moreover, most of them do not understand the signs of diseases, to talk of treatments. As such, this has put the impacts of disease on fish production on a relatively more severe level. For this reason, efforts have to give not only on the occurrence of disease and pathogens but also on the awareness development programme of farmers. Besides that, the government should take some effective initiatives such as manpower and infrastructure development and formulate different policies for fish Health management which can ensure the sustainable aquaculture production.

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(Manuscript received 27 November 2019)